Queensland University of Technology
Brisbane Australia

Spatial and Temporal Variation of Airborne Particle Concentration in the Yangtze River Basin

Lidia Morawska[1], Jianmin Chen[2], Rohan Jayaratne[1], Xingnan Ye[2], Chunlin Li[2]

[1]International Laboratory for Air Quality and Health, Queensland University of Technology, Brisbane, Australia.
[2]Shanghai Key Laboratory of Atmospheric Particle Pollution and Prevention, Department of Environmental Science and Engineering, Fudan University, Shanghai 200433 China
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Presenting author email: l.morawska@qut.edu.au

Introduction. We analyse the particle mass and number concentration data obtained during the extensive air quality monitoring campaign that was conducted in the Yangtze River Basin in November 2015. The monitoring was carried out aboard an instrumented boat which sailed from the Port of Shanghai up the Yangtze River through a distance of 1075 km to the city of Wuhan and back with a total journey time of 14 days. We will compare and contrast the particle concentrations in the many diverse environments constituting this region such as large cities, industry and rural farmland.

Methods. The instruments were housed in an 8 metre container placed on the deck of the boat and the air was sampled through inlet tubing protruding through the roof. The particle number concentration (PNC) was monitored continuously at 30 s intervals with a TSI 3787 condensation particle counter (CPC) which has a particle size detection range of 5 nm to 3 µm and can measure a maximum number concentration of 2.5x10^5 cm^{-3}. The instrument was operated at a low flow rate of 0.6 lpm which gave a response time of 1 s. The particle mass concentration ($PM_{2.5}$) was monitored with a Sidepak aerosol monitor AM510 set to obtain a reading every 2.5 min. This instrument has a maximum detectable particle mass concentration of 20 mg m^{-3}. Meteorological data such as air temperature, humidity, wind speed and direction, were monitored with an on-board weather station in real time and corresponding fixed-station data were also obtained from meteorological stations along the river bank.

Results. Fig1 shows the PNC at 30s intervals on a day when the boat sailed up the river all day without mooring. The PNC remained close to 1x10^4 cm^{-3}. However, we see many concentration spikes, some as high as 3x10^5 cm^{-3}. This pattern was typical and resulted from emission plumes from passing ships and industries and other combustion sources on the shore. For example, the boat passed through an industrial region around 9-10 h and past several straw fires on the shore near 16 h. Fig 2 shows the hourly median PNC and PM2.5 on this day. We see that the two types of combustion sources affected both the PNC and the PM2.5, although sharp spikes due to emissions from passing ships were not registered by the AM510 due to its longer sampling interval. Fig 3 investigates the relationship between the hourly PNC and PM2.5. We see a reasonably good linear correlation with an R^2 value of 0.35 which improves to 0.66 when the single wayward point due to the straw fires (indicated by the horizontal arrow) is removed.

The presentation will include a more detailed analysis of the results incorporating the prevalent wind and other conditions.

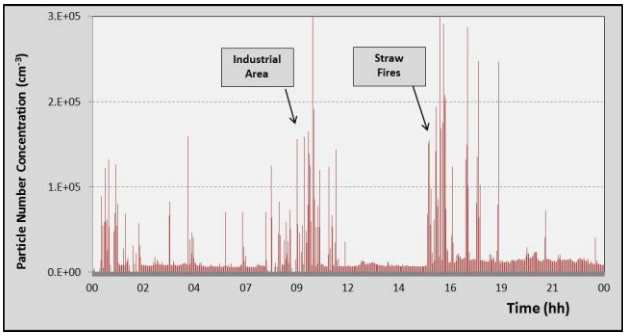

Fig 1: The PNC at 30s resolution obtained on the 27th of November. The spikes are due to combustion sources.

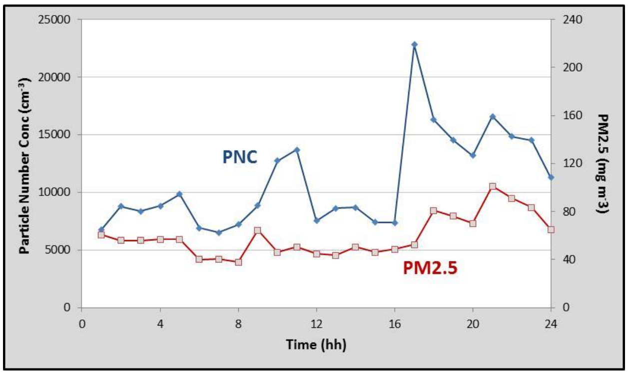

Fig 2: Hourly median PNC and PM2.5.

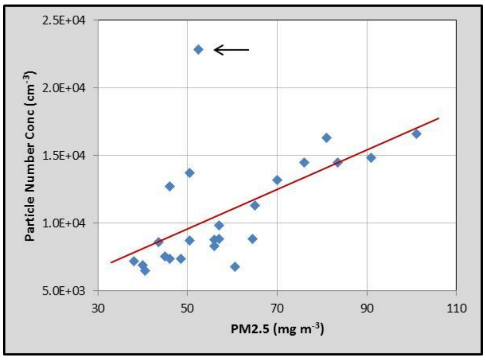

Fig 3: Plot of hourly median PNC and PM2.5.